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## **A New Steller Sea Lion Rookery in Glacier Bay National Park and Preserve**

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### *Final Report to:*

Glacier Bay National Park and Preserve  
P.O. Box 140  
Gustavus, Alaska 99826

### *For:*

Cooperative Agreement 9910-97-0026  
between the NPS and UAS

Submitted: May 2001  
Revisions Received: May 2001

Final Report: June 2001

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### **INTRODUCTION**

Graves Rocks, a Steller sea lion (*Eumetopias jubatus*) haulout (resting area) within Glacier Bay National Park and Preserve, was documented as a breeding area (rookery) for the first time in summer 2000 by Ken W. Pitcher (Alaska Department of Fish and Game, Anchorage, AK, pers. comm.), and it is likely that breeding activities began as early as 1995 or 1996. This site is the fifth known sea lion rookery in southeastern Alaska.

In this report, we document the colonization of Graves Rocks as a Steller sea lion haulout in the late-1980's and its transition to a rookery in the mid- or late 1990's. In August 1999 Pitcher observed sea lion pups on Graves Rocks, and in July 2000 he confirmed that females were whelping on site, rather than arriving with their pups from another rookery. This site had previously been a non-breeding haulout, apparently established as a haulout sometime after 1984 (Calkins and Pitcher 1982, Jettmar 1984). Regular use of the rocks as a resting area likely began before 1989 when more than 500 animals were observed during an aerial survey in June (Loughlin et al. 1992). From 1993 to the present, 400 to 900 sea lions have been regularly observed at Graves Rocks (NMFS, unpublished data; Mathews, unpublished data).

The National Marine Fisheries Service (NMFS) recognizes two stocks of Steller sea lions in the North Pacific (Ferrero et al. 2000). Breeding areas for the western and eastern stocks are divided at Cape Suckling (144°W latitude) (Loughlin 1997). The western stock of Steller sea lions are classified as endangered due to severely reduced numbers and ongoing declines; the number of sea lions in the western stock has declined by approximately 80-90% since the 1970's (Braham et al. 1980, Loughlin et al. 1992, Merrick et al. 1987, NMML 1995). In contrast, the eastern population is stable or increasing throughout most of its range and is classified as threatened under the

Endangered Species Act (ESA) (U.S. Federal Register 62:24345-24355). Sea lion numbers in southeastern Alaska (a subset of the eastern population) are stable or increasing slightly with a total estimate in 1998 of 19,000 non-pup sea lions (Calkins et al. 1999). Comparing the population dynamics of the two sea lion stocks is one approach to understanding the cause(s) of the steep declines in the western stock. The transition of Graves Rocks, from a haulout to a new rookery is likely a reflection of regional population growth in the eastern stock. Understanding the factors that promoted colonization of the haulout in the late 1980s and its recent conversion to a rookery may help determine why the population trajectories of the eastern and western stocks are so different.

There are 3 major rookeries in southeastern Alaska: the Forrester Island complex located northwest of Dixon Entrance, Hazy Island, and White Sisters Islands (2,798, 1,157 and 205 pups, respectively, in 1997) (Calkins et al. 1999). Biali Rocks is another new rookery currently not classified as a major rookery; 21 pups and 669 non-pups were counted at Biali Rocks in 2000 (K. W. Pitcher, ADF&G, pers. comm.).

The objectives of the field work in July 2000 were to: 1) conduct surveys of sea lion adults and pups at Graves Rocks using different methods, 2) record sightings of branded, tagged, entangled, or injured animals, 3) determine if there was an observation site which afforded a good view of the rocks occupied by sea lions, 4) begin developing methods for monitoring sea lions, including behavioral observations such as female-pup activity budgets, and 5) determine what options there might be for establishing a field camp nearby. In this report, we present the results of our short pilot study at Graves Rocks in July 2000, provide information on the colonization of the site as a resting area, and summarize available counts of Steller sea lions at Graves Rocks.

## **METHODS**

### ***Study Site***

Graves Rocks (58° 14' N, 136° 40' 55" W) are located along the outer coast of Glacier Bay, about 6 km northwest of Cape Spencer. In our observations since 1993, sea lions have occupied 5 of the rocky islands at the southernmost end of the complex (Fig. 1). We named the 5 rocks based on their relative locations (Northeast, Southwest, West, Northwest 1, and Northwest 2; NE, SW, W, NW1, and NW2) (Fig. 1b). The area is exposed to the Gulf of Alaska, where heavy sea states are common.

### ***Shore Based Surveys***

A rocky islet with two elevated knolls (~ 20 and 25 m high) north of the rookery (Fig. 1b) afforded a very good view of 4 of the 5 occupied rocks; from this vantage, Southeast (SE) island is partially blocked from view by NW1 and W islands. The distance from the observation site to NE island is 625 m and to NW2 it is 575 m. On 18 and 19 July we conducted simultaneous counts of sea lions from the eastern knoll using *Leica* 20 X 60 binoculars mounted on tripods. We used a hand-held tally counter to categorize sea lions as non-pups or pups, and separately tallied counts for each of the 5 occupied rocks. The observation island had signs of recent bear activity (scat and uprooted vegetation).

We used the *M/V Surfbird*, a ~65 ft. vessel operated by the U.S. Fish and Wildlife Service, as our base camp. The captain of the *Surfbird*, Joe McClung, transported us to and from the observation site in a 21 ft *Boston Whaler*, and we conducted the photographic surveys from the smaller vessel. We accessed the observation site from the north shore where there is less wave action. The dropoff required careful maneuvering at low tide to transfer personnel onto a rocky ledge. We secured a ~30 m line to a rock well above high tide to scale the island's rocky north face.

### ***Photographic and Visual Surveys from a Boat***

We made one visual count using binoculars from the top of the *M/V Surfbird* when we arrived at the site on 17 July, 2000. On 18, 19, and 20 July we circumnavigated the rocks occupied by sea lions to conduct photographic surveys. One person took one or more series of overlapping photographs of sea lions on each island from one side and then from the other side after the boat was repositioned. We recorded the following information for

each series of overlapping photographs: time, frames taken, haulout location (e.g., NW1), viewing direction (e.g., from the west or east), camera settings (F-stop and speed), and presence of pups or branded animals observed in an area. On 19 July we also measured the distance from the boat to the sea lions using laser range-finding binoculars (*Leica Geovid*s). We used a Nikon 9009 camera equipped with a 300 mm Nikon autofocus lens and loaded with color, slide film (Provia) rated at 400 ASA.

### ***Aerial Photographic Surveys***

We have flown aerial surveys for harbor seals in Glacier Bay in August since 1992, and each year we try to include photographic surveys of sea lions at Graves Rocks. In many years, however, fog along the outer coast has precluded these efforts. We analyzed aerial photographs of sea lions at Graves Rocks from the following dates:

1993	July	28, 29
1995	August	8, 10
1996	August	18, 19, 22, 24
1997	August	19

We took photographs from a single engine airplane at altitudes of approximately 300 m, using a SLR camera equipped with either an 80-200 zoom or a 300 mm lens was used with 400 ASA color slide film.

### ***Counts of Sea Lions from Photographs***

To analyze the photographs taken from the boat, we first grouped the slides by island (NE, SW, W, NW1, and NW2) combining all views for a complete survey of each island. We sorted the photographs using a light table and a slide lupe, and made counts from images with only a few sea lions using the lupe. If there were more than approximately 10 sea lions per slide we projected the image onto a white piece of paper and marked each animal as we counted using a tally-counter to record these higher counts. We carefully matched adjacent images to avoid over- or under-counting. Each slide was counted twice for verification. In almost all cases, recounts were identical to the first

count or differed by no more than 2 animals; if there were more than one set of overlapping images for an island during a survey, we used the highest count.

We sorted slides from aerial surveys such that the best series for complete coverage of each island could be counted. Otherwise, the counting methods were similar to those used for photographs from a boat.

### ***Observations of Branded, Tagged, and Entangled Sea Lions***

In 1994 and 1995, more than 800 Steller sea lion pups were branded at the Forrester Is and complex in southeastern Alaska (K.W. Pitcher, ADF&G, unpublished data), and additional animals will be branded in summer 2001 (Verify...).

We observed branded and entangled sea lions during both the photographic surveys from a vessel and from the observation island. We recorded brands using a datasheet that allowed a confidence ranking (1=excellent or 98-100% certain, 2=very good/80-97%, 3=good/60-79%, 5=poor/<50%) for each of the 4 digits as well as a 2<sup>nd</sup> likely candidate for digits that were distorted or partially hidden from view. During the vessel surveys, we photographed branded and injured sea lions using an SLR camera equipped with a 300 mm lens.

### ***Disturbance of Sea Lions by Vessels***

While we were near the rookery, we observed very little vessel traffic. During our 3 days in the area we did not observe disturbances of sea lions by vessels, other than that from our research vessel during close approaches for photographic or visual surveys. (We were working under an ESA research permit that allowed such “takes.”) During our surveys from a boat, we mainly observed increased activity levels (more heads raised as we passed by); very few sea lions abandoned the haulout even when we were motoring slowly within 100 m. On the evening of 17 July, 12 salmon trolling vessels anchored in Murphy Cove; we were not on site to observe their transit past the sea lions.

## RESULTS

### *Counts of Sea Lions from July 2000 and from Earlier Aerial Surveys*

On 17-19 July 2000 we conducted 8 counts of sea lions using 3 methods: visual counts from the *M/V Surfbird*, counts from shore (by 2 observers), and counts from photographs taken from a small boat. Counts of non-pups ranged from 496 to 890 sea lions; the best count of pups was 24, and this was a visual count from shore (Table 1). The high count of all age/sex classes was 900 sea lions on 20 July 2000; this was a count from photographs. Counts from the shore site were within 4-11% of the photographic counts from a boat on the same day (Table 1; 18 and 19, July). Our simultaneous counts of non-pups from shore were within 2% of one another (i.e., 690 vs. 703, and 496 vs. 504, Table 1); pup counts differed by 2 – 6 pups; the higher counts of pups were verified by consulting with one another after a count was completed.

In aerial photographs taken during late July and August from 1993-1997, we counted 416 to 941 sea lions at Graves Rocks (Table 1). Pups were not detected in these photographs. Counts of adult males and pups presented for this and other methods are minimal estimates of these age/sex categories.

### *Observations of Branded, Injured, and Entangled Animals*

Four branded animals (birth site = Forrester Island) were identified; 3 of these had also been observed at SMI in Glacier Bay in 1 to 4 other years (Table 2). Although the exact digits on one of the brands could not be determined, we had both observed this animal at SMI and were familiar with the brand scarring pattern. One of the branded sea lions observed at Graves Rocks, F604 (Fig. 2a), is one of the most commonly observed sea lions from SMI (Table 2). All of the branded animals that we observed were males (5 or 6 years old).

On 19 July we observed one sea lion with a constriction, possibly due to entanglement in fishing gear, around its neck. The mark encircled the base of the neck and pressed the skin inward, suggesting that a line constricting the animal's neck was still present. The

sea lion did not appear to be emaciated. We observed 3 sea lions with large raw wounds, possibly due to predation attempts. One animal was missing a patch of skin ( $\sim 0.3 \text{ m}^2$ ) on its back (Fig. 2b). Based on a photograph, Bruce Wright (NMFS, Juneau, AK, pers. comm.) suggested that the wound might have been caused by a sleeper shark (*Somniosus pacificus*).

### ***History of Breeding at Graves Rocks***

In the aerial photographs from 10 August 1995 and 19 August 1996 sea lions on the NW2 islet were distributed in what appeared to be harem-like aggregations. This suggests that breeding activities at Graves Rocks may have begun as early as 1995. Most breeding in Alaska occurs between the last part of May and late July (Hoover 1988), although territories can be maintained for 8-10 weeks after they are first established (Gentry 1970). Perturbation at Graves Rocks was confirmed in 2000; K.W. Pitcher (ADF&G, pers. comm.) counted 30 pups in August 2000, and we observed 24 pups at the rookery in mid-July 2000. We suspect that these estimates are conservative, since pups are small and easily missed during the counts. In addition, the July and August counts occurred after some young-of-the-year could have begun foraging with their mothers (Hoover 1988).

## **DISCUSSION**

The 3 different methods that we used to count sea lions in July 2000 yielded comparable results. Our counts from shore were very close to those from vessel surveys on the same days (17 and 18 July), and they were comparable to counts from aerial photographic surveys in other months (Table 1 and 3). Comparisons of the low-angle methods we used to those from a concurrent aerial photographic survey, ideally a survey using medium-format photography such that pups could be enumerated (Snyder et al. 2001), are needed to determine what proportion of animals are missed during counts from shore and from photographs taken from a boat. The SW islet (Fig. 1) was partially blocked from view from the shore site, so we expected the shore counts to be notably lower than counts from vessels, but they were not (Table 1, July 18 and 19). When sea lions are crowded, real time counts are likely to be higher than counts from photographs, since observers can see



more animals as they move into view during a real time count than they can from a low angle photograph. It is possible that this explains why our counts from shore were higher or very close to those from photographs taken from a boat. We found that visual counts from a boat were very difficult due to the movement of the boat.

### ***History of Use of Graves Rocks by Steller Sea Lions***

Regular use of Graves Rocks as a resting area appears to have begun in the mid to late 1980s. Steller sea lions were not observed on rocks outside of Graves Harbor during biweekly summer boat surveys of the outer coast by NPS rangers in 11 years between 1962 and 1984 (Jettmar 1984). In 1974, Greg Streveler (Icy Strait Consulting, Gustavus, AK) observed 11 and 3 Steller sea lions on Sugarloaf Island and rocks off Venisa Point, about 7 km north of Graves Rocks (Calkins and Pitcher 1982), and rocks outside Graves Harbor were occasionally used by 2-4 sea lions in late summer between 1973 and 1979 (C. Summer, NPS, pers. comm.). No sea lions were at either Venisa Point or Graves Rocks during ADF&G surveys in March or June, 1976 (Calkins and Pitcher 1982). During an aerial survey in June, 1989, 533 sea lions were reported for Venisa Point (Houghlin et al. 1992), although this count was actually for Graves Rocks (NMFS, unpublished data). In all years in which the NMFS conducted surveys for sea lions between 1989 and 2000, several hundred sea lions have been observed at Graves Rocks during June and other months (Table 3). From 1993-1997, we have observed 400-900 sea lions at Graves Rocks during opportunistic aerial surveys in July and August (Table 1). These observations indicate that Graves Rocks became a regularly used haulout between 1985 and 1989, and that it became a rookery approximately 11-14 years later.

Reports from NPS rangers and biologists, indicate that Graves Rocks was colonized as a non-breeding haulout after 1984 and before 1989. Since colonization, numbers during summer have fluctuated between 416 and 941 animals, with no clear trend indicated from relatively few counts (Tables 1 and 3). Calkins et al. (1999) did not detect a significant trend in numbers of sea lions from 1989 to 1996 at this site. Parturition at Graves Rocks occurred at least as early as 2000, but breeding activities probably began several years

earlier based on harem-like groupings observed in aerial photographs from 1995 and 1996. Changes in seasonal patterns in the number of sea lions at the SMI haulout within Glacier Bay (75 km from Graves Rocks) also suggest that the transition of Graves Rocks from a haulout to a rookery could have occurred around the mid-1990s. Between 1995 and 1997, mean and maximal counts of sea lions in July at SMI jumped by factors of more than 2 (mean) and 15 (max), (Mathews et al. 2001, in prep.). If Graves Rocks became a rookery around this time, it is possible that juvenile males were driven from the outer coast site by breeding males during the seasonal transition from a haulout to a rookery (Calkins and Pitcher 1982), and that many of these males moved to SMI, the nearest haulout. The increase in numbers of sea lions at SMI could also be due to other factors, such as a shift in prey distribution (Mathews et al. 2001, in prep.).

If it follows a pattern similar to those of other new rookeries in southeastern Alaska, the potential for growth in numbers of pups at Graves Rocks may be high. For example, in 1979, 30 pups were counted at Hazy Island, a new rookery at that time. By 1991, 808 pups were born (NMFS 1992) and in 1997 at least 1,157 females gave birth at Hazy Island (Calkins et al. 1999). Similarly, 3 pups were born at the White Sisters rookery in 1979, 95 in 1991 (NMFS 1992), and 205 in 1997 (Calkins et al. 1999).

#### ***Movements of Sea Lions within Glacier Bay National Park and Preserve***

The exchange of animals between SMI, the only sea lion haulout within Glacier Bay proper, and Graves Rocks may be fairly high, given that 3 of 4 branded animals observed during 3 days in July 2000 had also been observed at SMI (Table 2). Movement between these two sites could be determined by monitoring both sites for branded animals. We have obtained brand sightings and counts of sea lions from SMI by working with NPS staff and tourboat crew who visit the island every day during summer months (Mathews et al. 2001, in prep.). Because there are no regularly scheduled tourboats passing Graves Rocks, a directed effort to document branded animals would be of value. In addition to the use of brands, photographic identification of sea lions (Kammemeyer and Kelly 2001, in prep.) could be applied both for population estimates (using mark-recapture methodology) and to assess levels of movement between Graves Rocks and SMI. The

movements and foraging locations of sea lions at Graves Rocks could be determined by tagging animals with satellite, VHF or other locational tags; time depth recorders (TDRs) could provide details on diving and foraging behavior. Genetic analysis of tissue samples from breeding animals and pups at the new rookery could be used to elucidate the source(s) of breeding animals at this new rookery. However, there are currently no methods for collecting biological samples for genetic analysis from sea lions without handling them, other than by using sloughed intestinal cells found in scat (Reed et al. 1997).

### ***Potential Management Issues for Graves Rocks***

The transformation of Graves Rocks from a Steller sea lion haulout to a rookery may require additional protection of the area from human activities under the Marine Mammal Protection Act or the Endangered Species Act. Under the Marine Mammal Protection Act and the ESA “harassing” or changing the behavior of Steller sea lions is prohibited. Critical habitat for Steller sea lions in the eastern stock has been defined as a 3,000 ft (0.9 km) buffer zone around major rookeries and haulouts, including a vertical buffer zone (50 CFR 226.202). Graves Rocks is classified as a major haulout and this classification may need to be upgraded to “major rookery.” The proximity of the new rookery to Graves Harbor (Fig. 1) -- one of very few safe anchorages used by a large salmon trolling fleet as well as other vessels -- will make the enforcement of buffer zone regulations around Graves Rocks potentially in conflict with safe boating practices. While a 3,000 ft buffer zone would allow passage to and from Murphy Cove, under certain conditions it could make access to the anchorage difficult or dangerous. A sea lion/vessel interaction study could determine if vessels transiting to and from Murphy Cove change the behavior of sea lions at Graves Rocks. If so, such a study could also determine if disturbance could be reduced or eliminated by establishing recommended routes or speeds for vessels to enter Murphy Cove safely and without disturbing sea lions. Based on our limited time near the new rookery, it did not appear that vessels maintaining a steady course to and from Graves Harbor would disturb sea lions on the rookery; however, direct observations are needed to confirm or refute this supposition.

## ***Conclusion***

The transition of Graves Rocks from a haulout to a breeding area offers an opportunity to closely monitor the development and growth of a new Steller sea lion rookery.

Information about the ecological conditions and population dynamics that supported the initiation of a new rookery could provide an important contrast to declines occurring in the western stock. If breeding animals at Graves Rocks are older sea lions that have previously bred at another rookery, this suggests that adults have been displaced from a rookery where the density of animals or other conditions have made it less favorable, or that Graves Rocks provides better access to prey. On the other hand, if Graves Rocks has been colonized by primiparous females, high juvenile survival (perhaps with increased crowding at their birth site) is suggested. The source of adult breeding animals at Graves Rocks is not known, but further observations of branded animals could clarify if breeding animals come from Forrester Island or from other rookeries (if additional branding at other sites will occur). In only 3 days at Graves Rocks, we observed 4 male sea lions branded as pups at the Forrester Island breeding complex in 1994 and 1995 (Table 2); presumably these males had not yet bred, since most male Steller sea lions do not successfully defend a territory until they are 9 yrs old (Hoover 1988). Observations of branded, tagged, or naturally marked animals at Graves Rocks will improve our understanding of Steller sea lion dispersal and rookery formation.

## ***Acknowledgements***

We thank Joe McClung (USFWS) for his expertise in getting us to and from the study site safely and for his constructive input on aspects of the field logistics. Funding for this project was provided by Glacier Bay National Park Service, the Alaska Department of Fish and Game, and the U.S. Fish and Wildlife Service. We appreciate contributions from student assistants from the University of Alaska Southeast's, Research Experiences for Undergraduates program (Kristine Faloon, Aaron Hopkins, and Luke Robinson). This work was conducted under Ken Pitcher's (ADF&G) Endangered Species Act research permit. We thank Ken Pitcher for support in all aspects of the project. This report was improved by comments from Mary Beth Moss (NPS).

**Table 1.** Summary of counts of Steller sea lions at Graves Rocks by date and survey method. Counts of adult males and pups are minimal estimates of these age/sex categories.

Date	Time	Method/Platform	Adult Males	Non Pups	Pups	In Water	Total
7/28/93		aerial photo	47	892	**	2	941
7/29/93		aerial photo	15	737	**	2	754
8/8/95	8:58	aerial photo	31	776	**	7	814
8/10/95	9:05	aerial photo	44	737	**	8	789
8/18/96	13:00	aerial photo	13	403	**	0	416
8/19/96	10:37	aerial photo	39	833	**	1	873
8/22/96	12:25	aerial photo	20	623	**	10	653
8/24/96	16:05	aerial photo	23	900	**	0	923
8/19/97	10:00	aerial photo	34	678	**	9	721
7/17/00	17:50	visual from boat	*	597	13		610
7/18/00	10:11	photo from boat	29	658	10	7	704
7/18/00	15:30	visual from shore	*	703	18	34	755
7/18/00	15:30	visual from shore	*	690	24	22	736
7/19/00	11:02	photo from boat	35	497	7	43	582
7/19/00	12:38	visual from shore	*	504	18	9	531
7/19/00	12:38	visual from shore	*	496	16	11	523
7/20/00	9:16	photo from boat	63	827	10	0	900

\* adult males included in non pup category

\*\* no pups detected, but altitude may have precluded detection

**Table 2.** Observations of branded Steller sea lions observed at Graves Rocks in July, 2000.

Brand	Obs Date	Sex	Birth Yr	Branding Location**	Observed at SMI?	Years (# days observed) at SMI			
						1997	1998	1999	2000
F291	Jul 18	M	1994	Forrester, Lowrie 5C	Yes	16	20		
F604	Jul 18	M	1995	Forrester, Cape Horn S	Yes	22	19	7	3+
F41?	Jul 19	M*	1994	Forrester, __?__	Yes	15			
F554 or 559	Jul 20	M	1994	Forrester, Cape Horn Rks	No				

\* Gender determined by observation of genitalia; all other genders are from the ADF&G branding database

\*\* ADF&G, unpublished data

**Table 3.** Summary of counts of Steller sea lions at Graves Rocks from the NMFS, NMML database (unpublished data).

Year	Month	Day	Total Count
1989	6	17	533
1989	6	20	416
1990	7	8	937
1991	6	21	470
1992	6	10	348
1992	6	12	384
1993	3	13	151
1994	6	13	732
1994	11	29	296
1996	2	1	264
1996	6	22	475
1998	6	20	445
2000	6	24	492

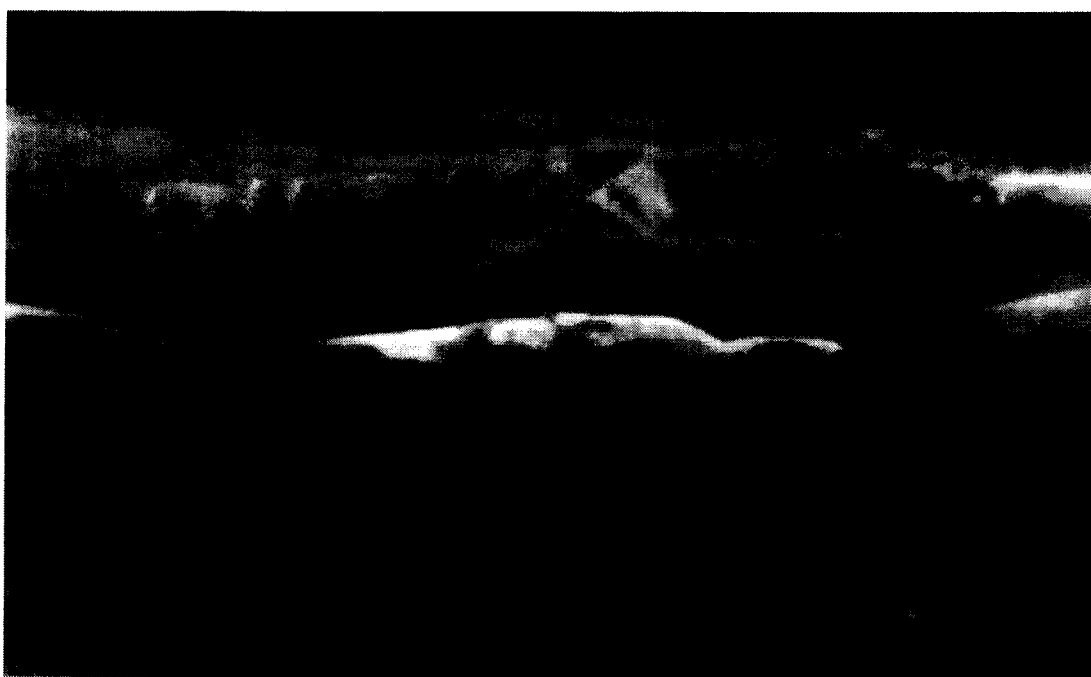
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**Figure 2. a)** Branded sea lion (F604) and **b)** injured Steller sea lions observed at Graves Rocks, July, 2000. (Images were scanned from color slides.)

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